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AMSAT NEWS SERVICE
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The AMSAT News Service bulletins are a free, weekly news and information service of AMSAT, the Radio Amateur Satellite Corporation. ANS publishes news related to Amateur Radio in Space including reports on the activities of a worldwide group of Amateur Radio operators who share an active interest in designing, building, launching and communicating through analog and digital Amateur Radio satellites.

The news feed on http://www.amsat.org publishes news of Amateur Radio in Space as soon as our volunteers can post it.

Please send any amateur satellite news or reports to: ans-editor [at] amsat.org

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ANS-190 AMSAT News Service Weekly Bulletins

To: All RADIO AMATEURS
From: Radio Amateur Satellite Corporation
712 H Street NE, Suite 1653
Washington, DC 20002

DATE 2023 July 9

2023 AMSAT Space Symposium First Call for Papers

This is the first call for papers for the 41st annual AMSAT Space Symposium to be held on the weekend of October 20-21, 2023 at the Sheraton DFW Airport in Dallas/Fort Worth, Texas

Proposals for symposium papers and presentations are invited on any topic of interest to the amateur satellite community. We request a tentative title of your presentation as soon as possible, with final copy submitted by October 12 for inclusion in the symposium proceedings. Abstracts and papers should be sent to Dan Schultz, N8FGV at n8fgv (at) amsat (dot) org.

[ANS thanks Dan Schultz, N8FGV for the above information]

Ariane 5 Rockets into Retirement: Europe's Workhorse Completes Final Mission

Europe's workhorse rocket has completed its final mission, launching two satellites into orbit before retiring after an illustrious 27-year career. The Ariane 5, known for its power and reliability, took off from Europe's Spaceport in Kourou, French Guiana on July 5, marking its 117th and last orbital liftoff.

The mission commenced at 6 p.m. EDT (2200 GMT), with the Ariane 5's 103-foot tall solid rocket boosters separating from the core stage approximately 2.5 minutes into flight. The core stage, powered by a single engine, continued its ascent, carrying the two satellites onboard. At around nine minutes after liftoff, the core stage shut down, and the upper stage separated to initiate its own burn. About 30 minutes into the flight, the first satellite, Heinrich-Hertz, was released into geostationary transfer orbit. Shortly after, the second payload, Syracuse 4B, followed suit.

Stéphane Israël, CEO of Arianespace, the France-based company operating the rocket, hailed the Ariane 5's flawless performance during the launch webcast. Israël described the rocket as a "legendary launcher" that had completed its work perfectly.

Heinrich-Hertz, an experimental communications satellite managed by the German space agency (DLR), will serve as a test platform for new hardware and conduct scientific and technical experiments in collaboration with universities and public sector organizations. This satellite represents Germany's first dedicated technology demonstration and communications research spacecraft.

Syracuse 4B, joining its predecessor Syracuse 4A launched in 2021, was built by Airbus Defence and Space for the French government. Both satellites are military communication relays, replacing Syracuse satellites 3A and 3B.

To reach geostationary orbit, located approximately 22,200 miles (35,800 kilometers) above Earth, Heinrich-Hertz and Syracuse 4B will perform a series of engine burns.

The retirement of Ariane 5 draws the curtain on its nearly 30-year operational career, during which it outperformed its predecessors, making it the most successful Ariane rocket to date. The European Space Agency (ESA) highlighted the rocket's technical prowess and reliability, describing it as a major asset for Europe's autonomous access to space.

Arianespace, in collaboration with ESA and the French space agency CNES, operated the two-stage Ariane 5, which was built by Airbus Defence and Space. Over the years, the rocket underwent several upgrades and operated in five different configurations. The most recent versions, Ariane 5 EC/A and ES, started operating in 2009, succeeding the Ariane G5, which flew from 2005 to 2009 after the brief G+ version and the original Ariane 5 G.

Although the Ariane 5 encountered an initial failure during its debut launch in 1996, failing to reach orbit and initiating an auto-destruct abort mid-flight, it went on to become one of the most reliable launchers worldwide. According to ESA, the rocket achieved a 96% success rate across its 117 missions and delivery of 239 payloads to orbit.

The development of the Ariane 5's successor, the Ariane 6, has been in progress for over a decade. The new rocket aims to be more flexible, cost-efficient, and capable of serving various types of launches compared to its predecessor. It will come in two configurations: A62, with two solid rocket boosters, and A64, with four. Originally slated for a 2020 debut, the Ariane 6 has faced delays, with the current estimate pointing to alate 2023 launch. This delay leaves Europe with a temporary gap in launch options until the Ariane 6 becomes operational.

To ensure continuity in European programs, the European Space Agency (ESA) has explored alternative launcher options from a technical, schedule, and security standpoint. In April, there were reports that the European Commission was considering using a SpaceX Falcon Heavy rocket to launch some of the European Union's Galileo navigation satellites, rather than waiting for the Ariane 6. However, ESA officials emphasized that Ariane 6 remains the preferred launch option for European missions requiring a heavy launch vehicle, and they are working diligently to ensure its inaugural flight.

The final mission of the Ariane 5 was initially scheduled for June 16 but faced delays. The first attempt was scrubbed due to issues with the solid rocket boosters' pyrotechnical transmission lines, while the second attempt on July 4 was hindered by unfavorable weather conditions.

As Europe bids farewell to the Ariane 5, the spotlight now shifts to the eagerly anticipated Ariane 6, which promises to usher in a new era of flexibility and cost efficiency in space launches. In the

meantime, efforts continue to bridge the launch gap and maintain the continuity of European space programs.

[ANS thanks Josh Dinner, Writing for Space.com for the above information]

CubeSats Deploy from ISS: Nanoracks Mission Advances Science and Education

NASA astronaut Stephen Bowen successfully deployed six CubeSats into low-Earth orbit outside the ISS Kibo module airlock on July 6th. The deployment was made possible by Nanoracks, a leading provider of commercial space services, who had been preparing for this mission named NRCSD-26. Sponsored by the ISS National Lab, the mission carried five CubeSats developed by Canadian universities, as well as a groundbreaking project by The Aerospace Corporation. Nanoracks, in collaboration with the Canadian Space Agency, handles the integration and deployment of these satellites from the ISS. The six CubeSats were transported to the ISS on SpaceX's CRS-28 mission.

This deployment marks an important milestone for the Canadian CubeSat Project (CCP), a collaboration between Nanoracks and the Canadian Space Agency (CSA). The objective of the CCP is to launch a CubeSat from each province and territory in Canada. The deployment of these CubeSats serves scientific purposes while also promoting hands-on experience and generating interest in STEM studies and careers.

The selected CubeSats for the NRCSD-26 mission represent a diverse range of scientific objectives, showcasing the capabilities and interests of Canadian universities.

One of the CubeSats, RADSAT-SK developed by the University of Saskatchewan, aims to test a radiation detection system and evaluate the effectiveness of radiation protection using a purified form of melanin, a natural pigment found in various organisms. Another CubeSat, ESSENCE from York University, focuses on monitoring solar storms, arctic ice, permafrost thaw, and forests in the Canadian Arctic region. It also aims to demonstrate satellite attitude recovery in the event of a failure in one of its actuators. Ukpik-1, developed by Western University, carries a virtual reality (VR) camera to capture 360-degree images and videos of Northern Canada. This CubeSat not only contributes to scientific research but also facilitates educational outreach and public engagement in Ontario and Nunavut.

The University of Manitoba's CubeSat, IRIS, is designed to observe the weathering of geological samples under direct solar and background cosmic radiation, aiming to detect any visually detectable changes that may occur over short time scales. SC-ODIN, developed by Concordia University, has the primary mission of collecting data on dust storms in Argentina and Namibia. Additionally, it monitors radiation received inside and outside the satellite over a period, providing valuable insights into radiation exposure in space.

In addition to the Canadian CubeSats, Nanoracks also deployed Moonlighter, built by The Aerospace Corporation. Moonlighter is a 3U CubeSat and holds the distinction of being the world's first hacking sandbox in space. Its purpose is to advance the understanding of cybersecurity as it pertains to space systems. The CubeSat will be utilized at the DEFCON conference by the Air Force/Space Force, where cybersecurity professionals will be challenged to hack a real-life satellite. For more information on Moonlighter and the Hack-a-Sat challenge, visit the official website at https://hackasat.com/.

[ANS thanks NASA and Nanoracks for the above information]

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Oblast region of Russia, marking the 14th launch from this site.

The Meteor-M2-3 satellite is part of the Meteor-M series, which aims to modernize Russia's national meteorological satellite system. Developed by NPP VNIIEM and sponsored by ROSCOSMOS, the series is designed to enable climate and environmental monitoring, exploration of Earth's natural resources, surveillance of solar activity, and data acquisition from automated data collection platforms. The satellite also features the COSPAS-SARSAT search and rescue system.

Meteor-M2-3 is equipped with advanced instruments, including an onboard radar complex based on an active phased array antenna, a shortwave reflected radiation meter, and a radio frequency mass spectrometer. These instruments enable all-weather radar surveillance of the Northern Sea Route and broaden the range of monitored parameters. The satellite has a lifespan of five years and is equipped with two deployable solar arrays.

In addition to the Meteor-M2-3 satellite, the mission carried various accompanying satellites. Sixteen CubeSats from the Space-Pi project were deployed into orbit as part of an agreement between ROSCOSMOS and the Innovation Promotion Fund of Russia. Nine satellites from the UniverSat program, led by ROSCOSMOS, were also launched, along with seventeen SmallSats for commercial customers.

The launch vehicle used for this mission was the Soyuz 2.1b rocket, belonging to the Soyuz 2 rocket family. The Soyuz rocket has been a reliable workhorse of the Soviet/Russian space program since its introduction in 1966. The Soyuz 2.1b variant stands approximately 152 feet (46.3 meters) tall and has a diameter of 9 feet (2.95 meters). It consists of three stages, all of which are expendable.

The first stage of the Soyuz 2.1b rocket includes four side boosters powered by RD-107A engines. These boosters perform the iconic "Korolev cross" pattern during separation. The center core stage is propelled by a single RD-108A engine, while the upper stage is equipped with a single RD-0124 engine. Both engines run on rocket-grade kerosene (RP-1) and liquid oxygen (LOx).

The mission did not involve the recovery of the first stage or fairings, as the Soyuz rocket does not possess such capabilities. The first stage of the rocket landed in the Zeysky District of Amur Oblast, Russia.

This launch marked several milestones: it was the 115th flight of an upper stage from the Fregat family, the first launch of a Soyuz 2.1b rocket in 2023, the 80th launch of a Soyuz 2.1b variant, and the 96th orbital launch attempt of 2023.

With the successful launch of the Meteor-M2-3 satellite and its accompanying payloads, ROSCOSMOS continues to enhance Russia's meteorological satellite system and expand its capabilities in climate monitoring, resource exploration, and search and rescue operations.

[ANS thanks Mariia Kiseleva, writing for Everyday Astronaut, for the above information]

Meteor-M2-3 Weather Imaging Satellite Now in Orbit and Transmitting Images

The latest addition to the Meteor-M satellite series, Meteor-M2-3, has successfully reached orbit and is already transmitting images of Earth. The Russian-owned weather imaging satellite was launched on a Soyuz-21.b rocket on June 27th. Previous iterations of the Meteor-M satellites faced premature mission terminations due to technical glitches or collisions with micro-meteorites.

Meteor-M satellites operate in a polar orbit, capturing and transmitting weather images in the LRPT format at a frequency of 137 MHz. This frequency range makes the reception of their signals as accessible as that of the older NOAA APT satellites. To receive these images, an appropriate 137 MHz satellite antenna is required, such as a V-Dipole, Turnstile, or QFH, along with a compatible software-defined radio (SDR) receiver like the popular RTL-SDR.

One of the recommended software options for receiving images from the Meteor-M2-3 satellite is SatDump. This user-friendly software offers binary releases for Windows and Android platforms, downloadable from SatDump GitHub Releases page: https://github.com/SatDump/SatDump/releases. Linux users can consult the SatDump Readme for a comprehensive build guide. It is worth noting that the SatDump graphical user interface has been reported to perform well on an Orange Pi 5, providing a convenient and portable solution for image reception.

To determine when the satellite is over your location you can use satellite tracking software such as Gpredict for Linux and Mac users, or Orbitron for Windows users. When utilizing Orbitron, it is important to run the software as an Administrator and update the Two-Line Elements (TLEs) to include the tracking data for the Meteor-M2-3 satellite found in the weather.txt TLE file. Consult the Meteor-M2-3 TLE (Two-Line Elements) available on Celestrak's website for precise tracking and monitoring.

Many satellite enthusiasts have already shared their successful reception of Meteor-M2-3's images to Twitter. The author of SatDump has revealed that work is underway to finalize projections for Meteor M2-3, and this should be ready to use in SatDump shortly. SDR++ software has now also integrated a Meteor Demodulator, further expanding the options available to those interested in receiving data from Meteor-M2-3.

Recent updates on Meteor-M2-3's progress from Happysat (https://github.com/happysat) indicate that telemetry data received on July 3rd suggests that the satellite's LRPT antenna might not have unfolded correctly, resulting in weaker-than-expected signals. It has also been reported that the satellite switched from transmitting on a frequency of 137.900 MHz to 137.100 MHz on July 4th, 2023.

[ANS thanks rtl-sdr.com and Happysat for the above information]

UMKA-1 School Satellite Sets Out to Explore the Skies

The UMKA-1 satellite, developed by schoolchildren from the Moscow Regional Educational Institution Secondary School No. 29 named after P.I. Zabrodin (Podolsk) in collaboration with SPUTNIKS LLC, was successfully launched into orbit on June 27, 2023. As part of the "Space-π" program and with the support of the Innovation Assistance Fund, UMKA-1 aims to train young students in spacecraft design, programming, and assembly, while also conducting astronomical observations using its high-aperture telescope, Leptonar-20955K.

The UMKA-1 satellite is a 3U+ CubeSat equipped with a Leptonar-20955K optical telescope and an astronomical digital camera called PlayerOne Saturn-C SQR. This compact satellite operates in two frequency bands, with telemetry transmission taking place on the UHF downlink frequency of 437.625 MHz, using GMSK USP modulation scheme at a rate of 2400 baud. Additionally, the transmission of data from the telescope occurs on the S band at a frequency of 2402 MHz. On June 18th, 2023, UMKA-1, known by its designated callsign RS40S, obtained its IARU Amateur Satellite Frequency Coordination.

Named after a beloved Soviet cartoon character, UMKA-1 carries the spirit of adventure and discovery. The mission team plans to share the main course of their mission, interesting events from the ground segment, and a transmission schedule on the S band with the wider community. Once the satellite is fully operational, a schedule will be published, and opportunities will be provided for the reception of images from the telescope.

Despite some minor setbacks during the installation process, the UMKA-1 team remains dedicated to the success of their mission. The initial format installation confusion has been addressed, and the satellite is currently undergoing testing. The team expects the telescope to be fully operational by the end of July, following which a transmission schedule will be made available.

Alexey Shafiev, RA3PPY, expressed gratitude to SPUTNIX for their support and guidance throughout the project. He acknowledged the enthusiasm and efforts of the young schoolchildren and students who form the bulk of the team. Their passion for space exploration is evident, and they have been actively involved in every aspect of the project.

In the past week, the telemetry transmission format was updated to use GMSK USP 2400 baud. The Mission Control Center (MCC) team will next focus on stabilizing the spacecraft and ensure the proper functioning of the guidance system. Subsequently, a two-week testing period for the payload will commence before UMKA-1 can fulfill its educational mission.

The UMKA-1 team assures the community that updates on their progress will be provided as soon as possible. Despite their current work rush, they value the interest and support from all those following their mission. Alexey, on behalf of the team, promises to respond to all the emails received thus far in the near future.

As of July 4, 2023, UMKA-1 remains operational in orbit, transmitting telemetry data pertaining to the satellite's operation. The team has made available a tool for decoding S band dump transmissions from the spacecraft, allowing enthusiasts to access the images collected by UMKA-1.

For radio amateurs keen on participating in the mission, the UMKA-1 team offers a QSL card as recognition for receiving telemetry from the satellite. To qualify, individuals must receive three packets of telemetry data and upload the collected information to the QSL card application form found at https://r4uab.ru/diplomnye-programmy-i-qsl/mka-umka-1/ within 24 hours of receiving the last telemetry package. The required software for receiving the telemetry information, such as "SoundModem USP" and "AGW Client R4UAB," is available to facilitate the process.

The UMKA-1 mission is an exciting endeavor that combines education, amateur radio, and scientific exploration. By encouraging young minds to explore the wonders of space, this project aims to inspire the next generation of scientists, engineers, and astronomers. The UMKA-1 team invites everyone to join them on this incredible journey as they unlock the secrets of the universe through their school telescope satellite.

More detailed information about the UMKA-1 satellite is available at https://sputnik.school29.ru/radio/. Individuals can visit the project's GitHub repository at https://github.com/radio-satellites/UmKa-1/ to obtain the software needed to decode the S band dump transmissions, which contain high resolution imagery from the telescope on board the satellite.

[ANS thanks Alexey Shafiev, RA3PPY and R4UAB.ru for the above information]

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20	KX9X	45	KEØWPA	70	KI7UXT	95	KF6JOQ
21	VE3HLS	46	K7TAB	71	W8LR	96	N6UTC
22	LU5ILA	47	KE9AJ	72	WA9JBQ	97	PP2RON
23	KE4AL	48	AA5PK	73	A41ZZ	98	VO1FUA
24	N7AGF	49	DL2GRC	74	HB9GWJ	99	VA3VGR
25	KI7UNJ	50	M1DDD	75	PT9ST	100	WI4T

[ANS thanks @GridMasterMap for the above information]

VUCC Satellite Standings as of July 1 2023

VUCC Satellite Award/Endorsement Change Summary for June 01, 2023 to July 1, 2023.

WA4NVM	1632	1639
WC7V	1351	1383
N8RO	1258	1298
N0JE	914	950
N3GS	873	932
DL2GRC	800	842
K7TAB	708	814
EA2AA	686	730
KQ4DO	675	710
WA4HFN	636	676
HB9AOF	500	604
OZ9AAR	500	600
N8MR	509	528
AC9DX	427	525
WB7QXU	451	500
JN2QCV	New	428
HB9GWJ	363	412
LU3FCA	310	406
JG6CDH	353	401
AB1OC	291	371
VA3VGR	302	352
EA3TA	301	350
JL1SAM	300	350
LU4FTA	268	346
AA9VI	122	336
JH0BBE	314	321
XE1BJ	New	304
DL8GAM	275	301
JA1GZK	256	300
PA7RA	245	299
AD5JK	263	296
JS1LQI	155	259
JE1TNL	225	250
N6PAZ	223	233
N9ZTS	201	231
IK1SLD	200	225
PU5DDC	151	181
ZS2BK	New	170
JE2UFF	100	158
DH0GSU	100	152
GM0WDD	New	115
EA4DEI	New	100

Congratulations to the new VUCC holders. GM0WDD is first VUCC Satellite holder from Scotland and IO85.

[ANS thanks Jon Goering, N7AZ for the above information]

Changes to AMSAT-NA TLE Distribution for July 7 2023

Two Line Elements or TLEs, often referred to as Keplerian elements or keps in the amateur community, are the inputs to the SGP4 standard mathematical model of spacecraft orbits used by most amateur tracking programs. Weekly updates are completely adequate for most amateur satellites. Elements in the TLE bulletin files are updated daily. TLE bulletin files are updated to add or remove satellites as necessary Thursday evenings around 2300 UTC, or more frequently if new high interest satellites are launched. More information may be found at https://www.amsat.org/keplerian-elements-resources/

This week there are no additions or deletions to the weekly AMSAT TLE distribution.

[ANS thanks AMSAT Orbital Elements page for the above information]

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To include your satellite roving plans in the AMSAT News Service Weekly bulletins, send them to Ian, K5ZM at k5zm (at) comcast (dot) net at least a couple of weeks in advance. Upcoming satellite operations are updated weekly on the AMSAT Upcoming Satellite Operations page but may expire before the next AMSAT News Service bulletin is released. You can watch for the latest roving information to become available at https://www.amsat.org/satellite-info/upcoming-satellite-operations/.

A growing number of satellite rovers are currently engaged in sharing their grid square activations on https://hams.at. By visiting the website, you gain easy access to comprehensive information about the operators responsible for activating specific grid squares. Additionally, you have the ability to assess the match score between yourself and a particular rover for a given pass, while also being able to identify the upcoming satellite passes that are accessible from your location.

[ANS thanks Ian Parsons, K5ZM, AMSAT rover page manager, for the above information]

Hamfests, Conventions, Maker Faires, and Other Events

AMSAT Ambassadors provide presentations, demonstrate communicating through amateur satellites, and host information tables at club meetings, hamfests, conventions, maker faires, and other events.

+ Small Satellite Conference
August 5-10, 2023
Utah State University, Logan, UT
More information at: https://smallsat.org/

+ 41st AMSAT Space Symposium & Annual General Meeting
October 20-21, 2023
Sheraton DFW Airport Hotel
4440 W John Carpenter Fwy, Irving, TX 75063

AMSAT Ambassador Clint Bradford, K6LCS, says,
“Think a 75-minute presentation on “working the easy satellites” would be appropriate for your club or event? Let me know by emailing me at k6lcsclint (at) gmail (dot) com or calling me at 909-999-SATS (7287)!”

[ANS thanks the AMSAT Events page for the above information]

Satellite Shorts From All Over

+ Congratulations to our latest GridMaster Award winners: Steve Nordahl, NS3L (#58) and Bill Attwood, VE6WK (#59). The GridMaster Award, AMSAT's most prestigious recognition, is available to amateur radio operators worldwide who establish two-way satellite communication with all 488 maidenhead grids within the contiguous United States. Contacts must be made from the same location or from locations within a 100-kilometer radius of a single location. Written confirmation, such as QSL cards or Logbook of the World (LoTW), is required. The GridMaster application and certificate fees have been underwritten by an anonymous donor. More information about this award can be found on the AMSAT website at https://www.amsat.org/gridmaster/. Congratulations again to Bill VE6WK and Steve NS3L for their remarkable accomplishments! (ANS thanks Bruce Paige, KK5DO, AMSAT Director of Contests and Awards for the above information)

+ Congratulations the following individuals on receiving the AMSAT Rover Award for their outstanding achievements in portable satellite operating: Olivier Tymkiw HB9GWJ (#077), Erwin Vink PA3GAN (#078), Doug Keech VA7LM (#079), and Bruce Patten VE7PTN (#080). To qualify for this award, they accumulated a minimum of 25 points by activating grid squares beyond their home grid. Points were earned through various achievements, including activating states, provinces, or DX entities outside their home location via satellite, as well as promoting their grid operations through social media and documenting their activations through photographs and published articles. More information about this award can be found on the AMSAT website at https://www.amsat.org/amsat-rover-award/. Congratulations to our esteemed AMSAT Rover Award recipients! (ANS thanks Bruce Paige, KK5DO, AMSAT Director of Contests and Awards for the above information)

+ Quetzal-1, a 1U CubeSat developed by Universidad del Valle de Guatemala operated successfully for two hundred and eleven days in-orbit a few years ago. The project just released a massive trove of open-source design documents, the software that ran on the satellite and ground station, and all the captured telemetry from the flight. It’s the ultimate bootstrap for anyone else designing a CubeSat, and hopefully provides enough clues to avoid some of the same issues. And if you want the details on the Quetzal-1 design, and what went wrong with the electrical system, two PDF papers have been released. Seeing more open source in space is an encouraging development, and one that should continue to grow as the cost of payloads to orbit continues to fall. Information on Quetzal-1 CubeSat can be found at http://github.com/Quetzal-1-CubeSat-Team. (ANS thanks Hackaday.com for the above information)

+ Youth on the Air Camp 2023 is a camp for young amateur radio operators in North, Central and South America. Campers will operate the special event station VE3YOTA while camp is in session with a special focus on satellite operations occurring Wednesday, July 19 from 1400Z to 1700Z (10 a.m. to 1 p.m. EDT). Additionally, an ARISS contact with the International Space Station is scheduled to take place on Tuesday, July 18 at 1842Z (2:42 p.m. EDT). For more information about the camp, please visit YouthOnTheAir.org or contact Camp Director Neil Rapp at director(a)youthontheair.org. (ANS thanks Neil Rapp, WB9VPG for the above information)

Join AMSAT today at https://launch.amsat.org/

In addition to regular membership, AMSAT offers membership to:

* Societies (a recognized group, clubs or organization).
* Primary and secondary school students are eligible for membership at one-half the standard yearly rate.
* Post-secondary school students enrolled in at least half-time status shall be eligible for the student rate for a maximum of 6 post-secondary years in this status.
* Memberships are available for annual and lifetime terms.

Contact info [at] amsat.org for additional membership information.

73 and remember to help Keep Amateur Radio in Space!

This week's ANS Editor, Mitch Ahrenstorff, ADØHJ
ad0hj [at] amsat.org